A METHOD FOR PREDICTING CARRIER QUALIFICATION SUCCESS IN THE COMBAT REPLACEMENT AIR WING

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THESIS

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ABSTRACT

A method for predicting Replacement Air Wing Carrier Qualification grades is examined. The data were supplied by Fighter Squadron One-Twenty-One, and subjected to multiple regression analyses in search of important variables that may be used in the prediction. Such have been identified and applied to the data. The results are extremely encouraging and a follow on study applied to a broader data base is suggested. Applicability and some economic factors are discussed.

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I. INTRODUCTION

Historically, the distinguishing characteristic of a Naval Aviator has been his ability to land a high performance aircraft on the deck of an aircraft carrier at sea. This is not only a proud trademark, but is considered by many to be the real mark of success and professionalism for pilots, for while many individuals have learned to fly quite competently, relatively few ever master the intricacies of carrier landing techniques. In large measure, then, if we are able to predict a pilots chance of success in mastering the carrier landing game, we will have predicted to a great extent his value to a squadron, and to the Navy. There can be no doubt, and we will examine some statistics to show this, if we are able to predict a lack of success at the ship, we can save vast amounts of money, time, and most important lives.

The particular problem addressed here came to light during a tour as the senior landing signal officer for the Pacific Fleet F-4 replacement training squadron, Fighter Squadron One-Twenty-One, (VF-121). Due to stringent limitations on time, aircraft, and carrier availability it became mandatory to try to pinpoint those individuals who would ultimately have a significant amount of difficulty during carrier qualifications very early in their training in order

to devote extra time and attention where it was available, in hopes of ensuring their ultimate success. It was felt, largely on the basis of experience, that instrument training grades in the Advanced Training Command, and in the Replacement Air Wing's instrument training squadron, were the strongest possible indicators of potential success or failure, but these predictions were based only on an intuitive "feel" for the situation. This project was started in order to attempt to provide some statistical support for these theories, or to debunk them thoroughly should that prove the case. In the event they proved successful, the object was to provide some formulation which would permit accurate predictions of carrier qualification performance, utilizing any factors which might be available in normal circumstances.

II. NATURE OF THE PROBLEM AND APPROACHES TAKEN

On completion of the Flight Training Command, the newly designated aviator (nugget) proceeds to one of the Combat Replacement Air Wings, accompanied by a relatively small and incomplete sample of his performance during training. The following specific scores, or grades, are forwarded:

1. Basic Training Command Standard Score
2. Advanced Training Command Standard Score
3. Ground School Standard Score
4. Stage Grades from Advanced Training to include:
    a. Familiarization
    b. Basic Instruments
    c. Instrument Navigation
    d. Advanced Familiarization
    e. Formation and Tactics
    f. Night Familiarization
    g. Operational Navigation
    h. Air-to-Ground
    i. Tactics
    j. Air-to-Air
    k. Carrier Qualifications

It must be recognized that a sizeable investment has been made in the individual pilot to this point, a subject of considerable study in itself. In a paper written for the

Naval Personnel Research and Development Laboratory in May of 1970, Joseph Taylor and Simon Arzigian break down the cost for an F-4 pilot as follows:

Naval Aviation Schools Command	$ 2,140.00
Primary / Basic Training	$ 3,195.00
Advanced Training	$123,848.00
Total	$129,183.00

The same reference contains similar figures for pilots trained in other aircraft types, although these figures are basically constant across the board. The aviator has received 14 to 18 months of intensive training to prepare him to step into a combat aircraft. In the next 90 to 180 days, the first year and a half he has spent in the Naval Aviation business will be made to look like grammar school, as he compares it to the postgraduate school of Naval Aviation, the "RAG". Here he will receive an intensive course designed to make him a combat ready fleet pilot, a course that culminates in Carrier Qualification in his particular aircraft, and which will cost the Navy another $163,776.00, in the case of the F-4 pilot. It should be apparent from these figures, that the ability to predict carrier qualification performance early in the game would pay off, not only in pinpointing specific individuals as being marginal, but can, if done early enough and with high enough accuracy, save a substantial sum of money by merely eliminating those individuals who are doomed to failure from the start.

There have been numerous attempts at finding correlations which might prove useful, perhaps one of the more interesting is contained in a paper written for the Naval Aerospace Medical Research Laboratory, Pensacola, Florida, by Lieutenant George M. Rickus Jr. Medical Service Corps, United States Naval Reserve. Lt. Rickus reported on a survey of flight surgeons conducted over a two year period. The flight surgeons were asked to identify and classify unsatisfactory aviators. The classifications were delineated and the flight surgeons identified 144 such aviators. The following breakdown resulted:

24 Men other pilots refused to fly with

43 Turned in their wings

32 Had their wings removed by board action

22 Were transferred administratively

23 Were given non flying duties

A control group of 146 aviators were also identified, these men were characterized as the "better" aviators in their respective squadrons. (Apparently Lt. Rickus had planned on using non-parametric methods, he does not so state, however, and the reason for this particular control group is never made clear in his paper.)

Lt. Rickus states, "A comparison of the available training statistics on the two groups indicated significant differences in three areas:

1. Peer rating
2. Basic Carrier Qualification
3. Advanced Flight Grade "

It is significant that two of the three areas found significant in this study are areas which are not forwarded to the Replacement Air Wing unless specifically requested, these are the Peer rating, and Basic Carrier Qualification scores.

The table which follows is presented as part of Lt. Rickus report. It provides a breakdown and cumulative frequency distribution of the 99 aviators from the above group for whom full training statistics exist, compared to 873 so called "satisfactory" aviators who had comparable statistics available.

FREQUENCY DISTRIBUTION OF BASIC CARRIER QUAL. GRADES

Grade Interval	Satisfactory N = 873		Unsatisfactory N = 99	
	Freq.	Cumulative Percentage	Freq.	Cumulative Percentage
Less than 2.70	9	1	5	5
2.71-2.75	0	1	1	6
2.76-2.80	0	1	4	10
2.81-2.85	36	5	10	20
2.86-2.90	36	9	8	28
2.91-2.95	81	19	14	42
2.96-3.00	81	28	30	73
3.01-3.05	387	72	10	83
3.06-3.10	126	87	5	88
3.11-3.15	72	95	6	94
3.16 or greater	43	100	6	100

Although the explanation of the table as it is contained in Lt. Rickus paper is incomplete at best it appears to point to the following conclusions:

1. By establishing a Basic Carrier Qualification grade of 2.80 it will be possible to eliminate 10% of the unsatisfactory aviators, while causing an attrition of only 1% among the satisfactory group.

2. By increasing the cutoff score to 2.90 we eliminate 28% of the unsatisfactory aviators, while forcing a 9% loss in the satisfactory ranks.

3. A further increase to 2.95 causes an attrition of 42% of the unsatisfactory group, while losing only 19% of the satisfactory group.

The term cutoff refers to simply terminating training for those individuals who fall below that grade point average for the stage involved.

Unfortunately Lt. Rickus has not identified his groups well enough to allow us to accept these conclusions at face value, in fact he presents no conclusions at all, merely offering the table as shown and allowing the reader to draw his own conclusions. It would be nice to be able to assume that the sample is a complete cross section of the fleet during the time that the study was undertaken, and that the conclusions we have drawn therefore hold true across the board in Naval Aviation. Since that issue is not addressed throughout the paper, further research is called for. If that assumption holds true the implication would be obvious,

particularly in the light of the cost figures quoted earlier. The optimum policy would simply be, maintain a very high grade cutoff point for Basic Carrier Qualifications, and allow only limited access to the Advanced Training Command. The end product should improve markedly, and the cost per copy should decrease. Even without further research this appears to be an acceptable method for obtaining a high quality product, the decision being one of understanding and accepting the tradeoff.

Another study, under the auspices of the same group, dated 2 March 1970, indicates a strong relationship between basic carrier qualification, and Advanced Training in the jet community, but little success in correlating Basic CQ with performance in the Combat Replacement Air Wing. The study indicates a very small correlation between Basic CQ and advanced multi-engine training, but it is felt that the results of the first study referenced, if they may be accepted, and the small additional cost of Basic CQ training for this category of pilots, provides a strong argument for allowing all fixed wing pilots to complete Basic CQ training, and use the results as a very definite attrition point.

It will be our purpose now to branch and look specifically at the jet community, and more particularly the F-4 pilots to see if some further predictors may be determined.

III. EXPERIMENTAL PROCEDURE

As has been stated, it is apparent that we should attempt to identify, as early as possible, those individuals who will fall in a marginal or unsatisfactory category during shipboard operations. Clearly, if the unsatisfactory individual can be identified, there is but one course of action, immediate forced attrition. In the case of the marginal individual some special attention may be sufficient to save the situation, and the money already invested. Towards this end a study of the "nugget" Naval Aviators who completed the West Coast F-4 Combat Replacement Air Wing, during a two year period, has been completed. The purpose of the study was to determine whether it was possible to predict performance on Carrier Qualifications within acceptable limits of accuracy.

The most frustrating part of the study was the collection of data. The proposed method of attack required a complete stage breakdown from the commencement of the Basic Training Command on through to eventually joining a fleet squadron. In addition it would be necessary for the sample size to be large enough to be satistically significant. It rapidly became apparent that, while various places maintain summaries and frequently standard scores, no one, easily accessible, location had the breakdown required. The single most helpful item was the fact that VF-121 at the Naval Air Station,

Miramar, California, maintained a file of training jackets covering several years, containing not only a stage by stage breakdown of training in the F-4, but, in addition, containing grades from the instrument refresher squadron, VF-126, and the list of grades alluded to earlier in this paper.

It is appropriate to comment at this point that an examination of grading statistics from the Basic and Advanced Training Commands show a very small standard deviation from the mean score for each stage, indicating a high degree of standardization in both instructional and grading techniques. For the sample examined the mean stage grades and associated standard deviations are given:

	Mean	Std. Dev.
a. Familiarization	3.06117	0.07527
b. Basic Instruments	3.08512	0.05305
c. Instrument Nav.	3.03888	0.04591
d. Advanced Fam.	3.02619	0.08597
e. Form. & Tact.	3.06449	0.04441
f. Night Fam.	3.06095	0.04801
g. Operational Nav.	3.08283	0.05723
h. Air-to-Ground	3.07762	0.07317
i. Tactics	3.08429	0.05799
j. Air-to-Air	3.05198	0.05030
k. C.Q.	3.01055	0.06623

Only those individuals who had never been carrier qualified in a fleet operational aircraft were considered in the sample. Complete statistics were available on 158 such

individuals, of these 8 were known to have had major difficulty landing aboard ship after joining their squadron, and had been removed from flying status either voluntarily, or through evaluation board action. It is interesting that no aviators were given evaluation boards for performance during Carrier Qualifications during this period, although several had been recommended by the Landing Signal Officers involved. Of the 8 individuals noted above, all had Carrier Qualification grades between 2.00 and 2.58 while in VF-121. Two other individuals fell within that same grade category, but in both cases they had gone on to do an acceptable job in the squadron. The mean score for Carrier Qualification in VF-121 for the entire sample was 2.81868, and the standard deviation was 0.23700.

On the basis of the records noted, the fact that 2.58 is almost exactly one standard deviation below the mean, and a certain amount of intuitive appeal, it was decided to try establishing 2.58 as a cutoff score. Any predicted Carrier Qualification grade below 2.58 constitutes justification for discontinuing training. To lend statistical credence to the hypothesis that 2.58 is a reasonable cutoff point, a discriminant analysis was performed using the UCLA Health Sciences Computing Facility BIMED program. The F test performed on the data reveals a significant difference in the two groups when using 2.58 as the cutoff point, significant to any level tabled in standard references, or at least the .999 level.

Two standard IBM package programs were then applied to the data, STEPR, and REGRE. STEPR takes the individual independent variables in a regression analysis, determines which order they should enter in, and enters them. REGRE takes the variables and enters them in the order instructed by the user. The use of the computer at this point was obvious and necessary. While the computations are not at all difficult, they are extremely time consuming when the number of possible combinations of indeperdent variables is taken into consideration. (15 independent variables were checked) The computer permitted a rapid survey of all variables to determine correlation with the dependent variable (C.Q. score), and was able to perform rapidly the computations using many different combinations of variables in a search for the strongest possible predictors.

As suspected, the most powerful predictor was one of the instrument grades. It was not, however, one of the Advanced Training Command grades as had been expected. The Instrument Refresher Squadron, VF-126, had the strongest positive correlation (.556). There are a number of potential explanations for this, none of which have anything more than intuition to support them as theories. The most appealing is, the newly designated aviator has been out of the cockpit for six to eight weeks while he has been on leave and in transit from his last duty station. When he climbs into the plane for the 10 flights in the Instrument Refresher syllabus he is not as sharp as he might be, and in fact often has a good deal

of apprehension about it. The tension generated, coupled with the fact that he is in a foreign atmosphere for the first time in weeks tends to simulate quite well the mental and physical strains he will encounter at the ship when he goes out for the first time. In addition the instrument skills he will be called on to use are exactly those he will be called upon to use a great deal in shipboard operations.

Although it is not possible to quote any authority as justification for these conclusions, they seem further supported when the second and third best predictors are found to be the Fam stage in the Advanced Training Command, and the Fam stage in the fleet aircraft itself. In each case similar tensions are readily apparent. It would be possible to go down the list of correlations, but that hardly seems beneficial in this case, we should note in passing, however, that there are two stages with pronounced negative correlation with Carrier Qualifications, they are Formation and Tactics, and Air-to-Air.

Once the correlation coefficients had been obtained, linear regression methods were employed in an attempt to predict performance not only reliably, but as early as possible as well. Once again the computer became an invaluable tool, for the method employed had to be largely trial and error. It was found that the highest accuracy could be obtained by permitting the pilot to complete the Familiarization, and Instrument Training stages within the F-4 squadron, however at that point a sizeable amount of ground school training, and

some 10-15 hours of flight time has been devoted to the individual pilot, a significant amount of the training funds have already been committed. An attempt was therefore made to back off and make the prediction as early as possible without a significant reduction in accuracy. The limit, with the data currently available, seems to be the completion of the Instrument Refresher Squadron, the following formula is appropriate:

Predicted C.Q. = -1.64886 + 0.78344 (a) + 0.71096 (b)

where (a) = Instrument Refresher Squadron Grade

(b) = Familiarization Stage grade from Advanced Training Command.

The standard error of estimate achieved using this formula is 0.191, and the accuracy of the predictions has some interesting characteristics.

IV. RESULTS AND CONCLUSIONS

In no case did the formula predict that any individual who was ultimately successful in the fleet would fall below the cutoff point of 2.58, that was true even in the case of the two pilots who had low Carrier Qualification grades, but had done an acceptable job in a fleet squadron. All of the 8 individuals who had eventually proven unacceptable were pinpointed by the formula. Closer inspection of the individual scores involved revealed that the two who were not predicted to have problems had mean scores in the two significant areas as shown:

a. Instrument Refresher 2.88

b. Fam. Stage 3.00

On the other hand the 8 pinpointed by the formula had:

a. Instrument Refresher 2.35

b. Fam. Stage 3.06

Note that the Instrument Refresher grade was higher for the two aviators not identified by the prediction equation, whereas the Fam. stage grade was lower. This might appear as a discrepancy because both of these variables are positively correlated with the Carrier Qualification forecast. Closer examination reveals that the above two Instrument Refresher grades are more than four standard deviations apart (n.b. standard deviation for this stage is .13363) whereas the Fam.

stage grades differ by less than one standard deviation (Fam. stage standard deviation is .07527). Thus, in the particular cases examined the spread in the one variable overwhelms the small (reversed) spread in the other. This phenomena is not at all unusual in the application of regression analysis.

Claims of 100% accuracy are at best unwise, and often refutable, but the evidence does seem to support a much more detailed analysis of a broader group of data, particularly since all estimates generated by using this formula erred on the high, or safe, side. There are several areas which will require financial and administrative support not obtainable at this time.

The results reported on are only valid in the case of Fighter Squadron One-Twenty-One, and may not be applied across the board without further investigation. Additionally the results available to this point would have value only to the Commanding Officer of the Fleet Replacement Training Squadrons, and not to the Bureau of Naval Personnel. These problem areas may both be dealt with simply by providing adequate support, in the form of the required grading statistics for the most part, to enable the area to be more thoroughly researched. This must include a complete stage breakdown from the time the subjects enter the Training Command, until joining a fleet squadron, and must constitute a statistically significant sample for each of the separate aviation communities by aircraft type. It is felt that this paper clearly demonstrates

a substantial potential for significant long term gains, both financially, and in the quality of fleet aviators.

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13. ABSTRACT

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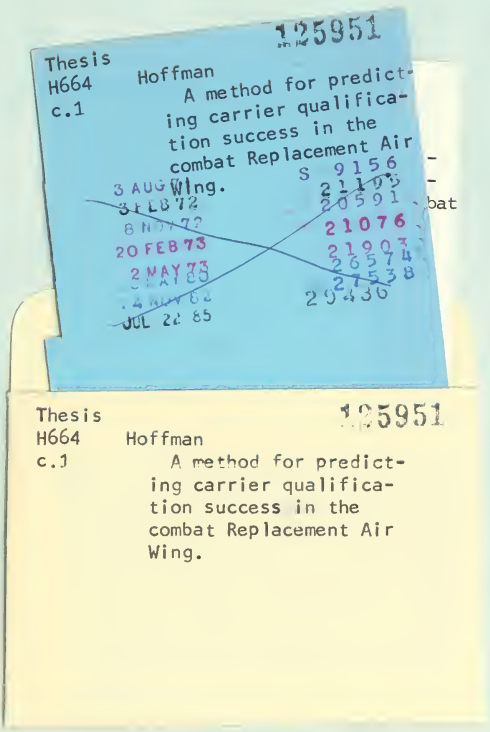
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